

TITLE

CONTROL DEVICE AND CONTROL METHOD FOR AN ELEVATOR
INSTALLATION WITH MULTIPLE CARS

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BACKGROUND OF THE INVENTION

The present invention relates to a control device for an elevator installation having a plurality of cars serving multiple floors simultaneously, and a method for controlling such an elevator installation.

An elevator installation having double cars includes a control that permits the 10 upper as well as the lower cars to be used at a main floor for travel to both even-numbered and odd-numbered floors is shown in U.S. Patent No. 5,086,883.

All modern controls for elevator installations with multiple cars, for example double cars (double-deckers), strive for minimization of the number of stops and thus also the cycle or travel time. In the case of double-decker controls, the embarking and 15 disembarking persons at two adjacent floors can be served, as far as possible, simultaneously. In order to fulfil this task, in the case of buildings equipped with multiple car elevators, for example double-decker elevators, two zones have to be separately considered:

Zone a) The main stopping point, i.e. usually the building entrance (lobby). The 20 main stopping point comprises in correspondence with the car deck number of the multiple cars at least two, usually the two lowermost, stopping point floors. The main stops of the main stopping point (lobby) are usually connected by escalators. There thousands of passengers flow into and out of the building on a daily basis. For the elevator control the most important feature here is the same elevator position at the stop: 25 the lowermost deck stops at the lowermost main stop floor of the main stopping point, thus as a rule the lobby.

Zone b) The other floors, thus, for example, the upper floors above the main stopping point. There the multiple car elevators, for example double-decker elevators, are so controlled in the case of between-floor traffic with advantage that they 30 simultaneously serve those two adjacent floors where passengers embark or disembark. The passenger waiting on such a floor accordingly cannot select the deck by which he or she is conveyed.

Known control algorithms - see, for example, the algorithm shown in EP 1 193 207 - offer solutions for the zone b) optimized to a greater or lesser extent. The proposed invention fully optimizes the control for journeys from the zone a).

For "filling" of the building in good time it is important that the elevators starting 5 from the main stopping point avoid "overlapping" stops (for example, floors 13/14 and then floors 14/15). This problem was previously solved (see, for example, EP 0 301 178) in such a manner that on the lower main stopping floor only the passengers with uneven floor destinations embark and in the upper floor those with destinations to even floors embark. This regulation applied not only for classical two-button controls, but also for 10 new destination call controls.

Other solution possibilities were also proposed. Thus, in EP 0 624 540 a feasible elevator allocation by "preliminary information" from the passenger is proposed. On entry into the elevators the passenger selects one of the channels, wherein each channel is associated with a floor zone. The individual zones here consist of several floors.

15 The U.S. Patent No. 5,086,883 mentioned above describes another solution for a destination call control. An elevator installation comprising a double-deck elevator group is selectively subdivided so that approximately half the elevators belong to the subgroup even/uneven and the second subgroup to uneven/even. The multiple cars are thus controlled in dependence on the divisibility of the number of the destination floor by 20 the number of car decks per multiple car. Thus, every passenger at the two lobby floors should be spared use of the escalator, because an elevator can always be allocated to him or her independently of the evenness or unevenness of the destination floor. The individual multiple cars are, however, in that case always controlled with the so-called "restricted service", i.e. one of the car decks always stops at an even-numbered floor and 25 the other at an uneven-numbered floor. The allocation of the passenger by his determined travel call, indicated by his or her destination call, to a car deck actually serving the even floors or to a car deck actually serving the uneven floors is also carried out in corresponding manner.

The known solutions have a few disadvantages - the passenger has to at least 30 know what even and uneven mean or then in which zone his or her destination floor is located. In the case of the zone channels a regular building user cannot develop a behavioral stereotype with the same elevator group, because possibly different channels

have to be used for different destinations. In addition, the apparently elegant solution of subdivision of the elevator group into even/uneven and uneven/even subgroups conceals the disadvantage that the waiting times for some passengers are significantly increased.

The greatest problem arises when the floor designations in the building do not correspond with the numbering of the possible stops of the elevators. In such a case the decision of the passenger with regard to the evenness/unevenness of his or her destination floor (generally divisibility of the destination floor number by the car deck number) does not correspond with that which the control considers on the basis of the number of possible stopping point pairs (stopping point triples in the case of triple cars, etc.). This problem can also arise as soon as the elevator group has blind zones or express zones (i.e. floors which are not served). Sometimes even several blind zones of different length are present and thus the selection of the most favorable stopping point pairs with respect to even/uneven or uneven/even can change several times.

The object of the present invention is to improve a control device, an elevator installation, and a building in such a manner that the building filling takes place more quickly with elevator passengers starting from the main stopping point.

SUMMARY OF THE INVENTION

For control of the operation with respect to the above-mentioned zone a), a significant improvement is achieved for the destination call control at the main stopping point with the solution according to the present invention. In accordance with the present invention, the control uses a dynamic conversion unit. Advantageously the conversion unit is adapted to the building layout.

The conversion unit or the control steps which it can perform assist the deck allocation and preferably also the elevator allocation in the case of an elevator group in such a manner that each elevator in the case of distribution travel starting out from the main stopping point, for example the lobby, selects only the non-overlapping stops and correspondingly allocates the passengers to the most suitable deck (and elevator). Thus the cycle times are reduced, transport capacity increased and waiting times shortened. The passenger selects his or her destination floor, and the allocated deck (in that case also the lower or upper lobby) - and optionally also the allocated elevator - is immediately

indicated to him or her on the indicating device, for example a display, at the destination call registration device.

The advantage relative to the previous solutions is that the passenger does not have to make any decision about the evenness/unevenness (or other divisibility by the 5 number of the car decks) of his or her destination floor. Such a decision could possibly be counter-productive. A further advantage is to be seen in the fact that particularly in the case of "traffic peaks during the upward peak traffic" the passengers are optimally distributed to all decks and, in a given case, elevators.

The designation "dynamic" signifies according to the preferred form of 10 embodiment that there is no statistical allocation of car decks of individual elevators to a specific floor group (for example even/uneven) during an elevator journey. The conversion unit can thus not only solve the problem of an inconsistency between the floor designation in the building and a stop number numeration within the control, but according to a respective situation also permits grouping of passengers with even and 15 uneven destinations in one deck. In correspondence with the function of the conversion unit to optimally process traffic peaks in the case of (upward) journeys starting from the lobby or like main stopping point these could also be differently denoted, for example SUPU (Super Up Peak Unit).

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DESCRIPTION OF THE DRAWINGS

The above, as well as other advantages of the present invention, will become readily apparent to those skilled in the art from the following detailed description of a preferred embodiment when considered in the light of the accompanying drawings in which:

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Fig. 1 is a schematic illustration of an elevator shaft of an elevator installation in a building, wherein the elevator installation serves floors of different height and express or blind zones, as well as a multiple car in the form of a double-deck car with two car decks disposed one above the other, wherein the numeration of the floors, a numeration carried out within the control and a numeration of the possible stops of the double-deck 30 car are compared in different columns alongside one another;

Fig. 2A is a schematic illustration of the possible stopping positions of a double-deck car in the case of a journey, which starts from a main stopping point, with an elevator control according to the state of the art;

Fig. 2B is a schematic illustration of an elevator shaft of an elevator installation
5 with a double-deck car and the stopping positions for execution of the same travel orders
as in Fig. 2A, but in the case of the control according to the present invention; and

Fig. 3 is a schematic illustration of an embodiment of an elevator control
according to the present invention for an elevator of an elevator group with double-deck
cars.

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DESCRIPTION OF THE PREFERRED EMBODIMENT

In the description which follows here as well as in the drawings the numberings
of floors or stops are placed in quotes on each occasion in order to distinguish them from
the reference numerals.

15 Fig. 1 shows on the left an elevator shaft 1 in which the respective floors to be
served by an elevator with a double-deck car 4 are indicated. The respective building
floor number **GSNR** is indicated alongside at the right in a first column. A possible floor
numeration **SINR** internal to the control is indicated alongside further to the right.

Respective stopping positions **HPA** of the double-deck car 4 (see Fig. 3) are illustrated in
20 a further column and provided with a possible stop numbering **HNR**. It may be assumed
that the corresponding elevator does not serve the floors "3" to "9" and "21" to "39".
These floors thus form the blind zones **BZ** or express zones through which the elevator
can pass in rapid travel.

The problem of different numbering of the floors of the "building side" and
25 "control internal" on the other hand is illustrated in Fig. 1. With consideration of the
illustration in Fig. 1 it is apparent that virtually every physical level in the building can be
denoted by several numbers. For example, the building floor "40" (this is also known as
such to the passenger) is only the fourteenth stopping point (**SINR**) which is served as
seen from the control, but then is the fifteenth or sixteenth possible stopping point
30 (**HNR**) of the double-deck car 4. This has to be taken into consideration by the control.
It is apparent from the drawing that the association of a lower car deck 5 (Fig. 3) with an
uneven floor and an upper car deck 6 with an even floor is not always practicable. Thus,

for example, in the case of a destination call to the building floor "10" (**GSNR**) the double car **4** stops with the lower car deck **5** in the blind zone **BZ** of the floor "9" which is not served.

Schematic illustrations of an elevator shaft are shown in Figures 2A and 2B.

- 5 There are illustrated the positions of the double car **4** during a distribution travel in the case of upward peak traffic that could happen. For a better overview in both cases only four passengers with, in both cases, the same travel desires are considered.

Fig. 2A shows the previously known solution with a so-called "restricted service" (even/uneven decision). It is assumed that the passengers would like to travel from the 10 double-deck lobby forming the main stopping points **HH** (floors "1" and "2" form the main stopping floors) to the floors "11", "12", "18" and "19". Different stopping positions of the double car of an elevator according to the state of the art during processing of travel orders are shown in Fig. 2A. It may thus be assumed that passengers with the destination floors "11", "12", "18" and "19" are to be allocated at a main 15 stopping point **HH** which comprises the floor "1" as a first main stopping floor and the floor "2" as a second main stopping floor. The main stopping point **HH** is approached by the double-deck elevator in such a manner that the lower car deck stops at the floor "1" and the upper car deck at the upper floor "2". The two main stopping floors "1" and "2" are connected by an escalator or the like, as is explained in more detail hereinafter.

20 In the case of the solution according to the state of the art (Fig. 2A) the passengers with the destination floors "11" and "19" get into the lower car deck and those with the destination floors "12" and "18" into the upper car deck. The elevator then stops at "11/12", wherein the two passengers with the destination floors "11" and "12" can disembark simultaneously. Thereafter the elevator travels to the position "17/18" in 25 order to let the passenger with the destination floor "18" in the upper car deck disembark. A further short travel, which is conducted to the position "18/19", is necessary in order to transport the passenger in the lower car deck to his or her destination floor "19".

In Fig. 2B there are shown the possible stops of an elevator installation with a double car which corresponds with the elevator car of Fig. 2A and is to execute the same 30 travel orders, but the control of which is provided with a conversion unit **SUPU** (Fig. 3). This conversion unit dynamically allocates the passengers, who register their destination floor at the main stopping point **HH** by way of a destination call registration device **11**

(Fig. 3), in correspondence with the travel orders already assigned to the double car 4, wherein the possible allocations are compared with respect to which allocation in the succeeding journey gives the minimum stopping halts.

The conversion unit **SUPU** optimizes the allocation of the passengers to the individual car decks on the basis of the call situation supplied by the control module of the selected elevator. In this case the passengers with the destination floors "11" and "18" are conveyed in the lower car deck and the passengers with the destination floors "12" and "19" are conveyed in the upper car deck. Thus, only two stops at the positions "11/12" and "18/19" are necessary in order to transport all passengers to their destinations.

The advantages of the solution with the conversion unit **SUPU** (Fig. 2B) are apparent by a comparison with the previous double-deck controls with the so-termed "restricted service" (illustrated in Fig. 2A), as are known from, for example, EP 0 301 178 or also U.S. Patent No. 5,086,883. Express reference is made to both specifications for more specific details of equipping, by way of example, in terms of hardware, of the elevator installation coming into question here.

By comparison of the two illustrations according to Figs. 2A and 2B it is clear that the use of the conversion unit **SUPU** can reduce the number of stops per round journey.

A concrete example of an embodiment of an elevator installation, which serves the building according to Fig. 1, with a control is illustrated in Fig. 3.

The elevator shaft 1 for an elevator A or an elevator group consisting of several elevators is illustrated in Fig. 3. A hoisting drive motor 2 drives, by way of a conveying cable 3, the double car 4 which is guided in the elevator shaft 1 and has the two car decks 5, 6 arranged in a common car frame. It may be assumed that the illustrated elevator installation is disposed in the building, which is indicated entirely at the left in Fig. 1, with forty-one floors and serves, with interposition of blind zones **BZ** (not illustrated in Fig. 3), only a part of these floors of the building.

The spacing of the two car decks 5, 6 from one another is so selected that it corresponds with the spacing of two adjacent floors. If there are one or more taller floors, the control device must take that spacing into consideration. The main stopping point **HH** present at the ground floor has in the floor "1" a lower access **L1** to the lower

car deck 5 and in the floor "2" an upper access L2 to the upper car deck 6 of the double car 4. The two accesses L1, L2 are connected together by an escalator 7.

The hoisting drive motor 2 is controlled by, for example, a drive control known in principle from the patent EP 0 026 406, wherein the target value generation, regulating function and stop initiation are carried out by means of a control device 8 which is constructed as a microcomputer system. The control device 8 is connected with measuring and setting elements 9 of the drive control. The control device 8 can also take over still further tasks, as is described in detail and illustrated in the U.S. Patent No. 5,086.883. For example, also load measuring devices 10 are connected with the control device 8.

The call registration devices 11, which are, for example, known from the patent EP 0 320 583 and which comprise decade keyboards, by means of which calls for journeys to desired destination floors can be input, are provided at the floors. As described in the U.S. Patent No. 5,086,883 these are connected by a data conductor 12 with the control device 8. The control devices 8 of the individual elevators of the group are connected together by way of a first comparison device 13 known from EP 0 050 304 and a party-line transmission system 14 known from EP 0 050 305.

The conversion unit SUPU, which in the case of the control of the elevator installation leads to a minimization of the stops for a journey starting from the main stopping point HH, is formed in the control unit 8 by software modules. The conversion unit SUPU comprises a second comparison device VE and a selecting device AE.

The corresponding call registration device 11 is disposed at the main stopping point HH at, for example, a region in front of the escalator 7 where the paths to the two accesses L1 and L2 branch off from one another. Here a passenger P can input his or her desired destination floor by way of the decade keyboard. In the case of the elevator A there are then possible allocations of the passenger P to the upper car deck 6 or the lower car deck 5. These two allocations are compared, on the basis of travel orders already allocated to the individual car decks, with one another with respect to the then-necessary stops in the succeeding upward number. That allocation which gives the smallest number of stops is then selected by the selecting device AE and indicated to the passenger by way of an indicating device 11a of the call registration device 11. In the illustrated example an upwardly pointing arrow for the upper car deck 6 illuminates.

In the case of the comparison of the elevator stops to be undertaken by a specific allocation, those already allocated to the individual car decks of the elevators **A**, **B**, **C** ... and the building structure, as it is apparent from Fig. 1, are taken into consideration. For this purpose in the comparison device it is calculated for a specific allocation at which of
5 the stopping positions **HPA** "1" to "16" the elevator car **4** has to stop for this allocation. The corresponding stops are counted and compared with the correspondingly ascertained stops for the remaining allocations. Then that allocation which gives the smallest number of overall stops is selected by the selecting device **AE** and indicated to the passenger **P** by the indicating device **11**. According to that a lamp "A" for the elevator **A**
10 illuminates at the device **11** in the example illustrated here. Clearly, a choice minimizing stops is to allocate to the passenger a car deck that already must stop at the passenger's destination floor to embark or disembark another passenger. If that choice is not available, another choice is to allocate to the passenger a car deck that already must stop at the passenger's destination floor due to an allocated stop of another car deck to embark
15 or disembark another passenger.

The journey following the allocation and boarding of the passenger **P** is then carried out in correspondence with the effected allocation with the minimized number of stops.

In accordance with the provisions of the patent statutes, the present invention has
20 been described in what is considered to represent its preferred embodiment. However, it should be noted that the invention can be practiced otherwise than as specifically illustrated and described without departing from its spirit or scope.